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January 9, 2018

Reginald G. Dawkins, Jr., P.G.
Sr. Geologist
Black & Veatch Special Projects Corp.
Black & Veatch
1120 Sanctuary Parkway, Suite 200
Alpharetta, GA 30009

Re: Barite Hill Mine Phase II (2017) Willowstick Geophysical Investigation
Sub: Final Report

Dear Reginald:

Introduction

This report presents the results of a Phase II Willowstick® geophysical groundwater investigation to confirm and further characterize two previously identified groundwater flow paths infiltrating the Capped Waste Rock (CWR) area at the Barite Hill Mine located near McCormick, South Carolina.

Background

During the Phase I work conducted in May 2016 (see Appendix A), Willowstick performed three surveys, which together identified two preferential groundwater flow paths that appeared to merge and infiltrate the CWR near the southwest corner of the site. Figure 1 shows a slice of the electric current density (ECD) model of Survey 1 at elevation 375 feet msl. The green shading highlights areas where electric current preferentially concentrates above normal (more than predicted in a homogeneous-earth case, for further details see Appendix A) and the purple identifies lower than normal. The light blue in some areas indicates electric current concentration was similar to normal. In Figure 1, the continuous green shaded zones were interpreted as the preferential groundwater flow paths. The two flow paths infiltrating the CWR are labeled according to the direction from which they come—the south (or southwest, as we will refer to it hereafter) groundwater flow path and the southeast groundwater flow path.

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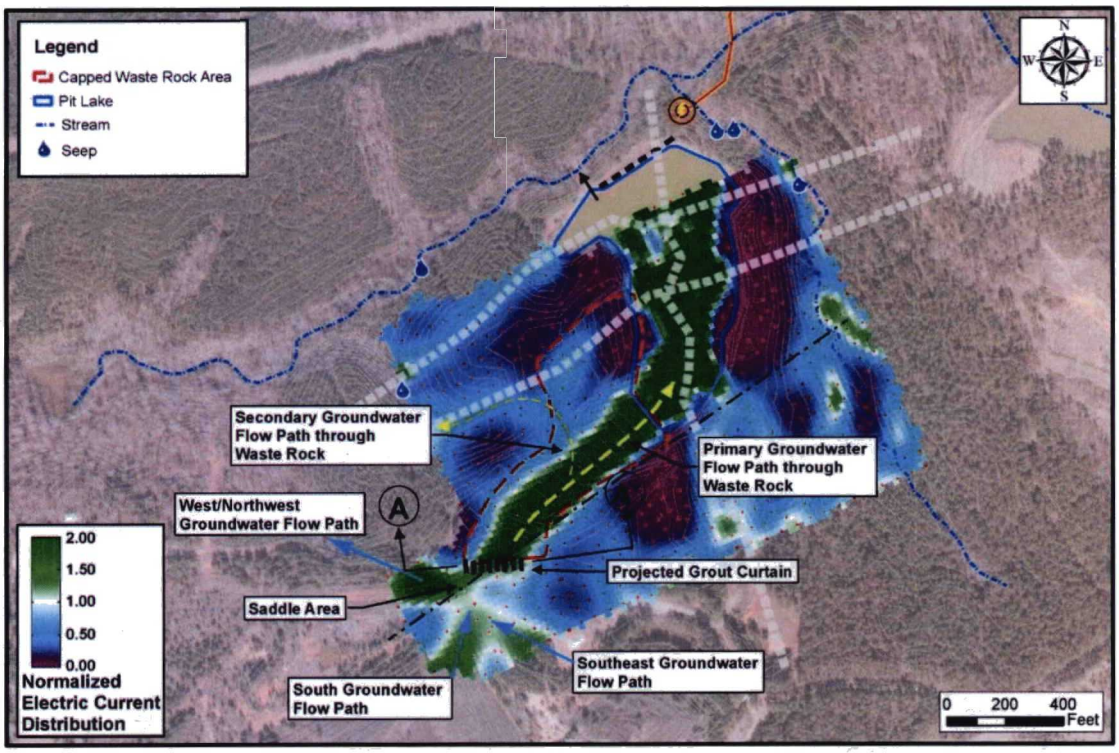

Figure 1 – 2016 ECD Model Slice (Survey 1) at Elevation 375 ft, with Interpretation

It was implied in the Phase I report that it might be possible to cut off groundwater from infiltrating the CWR by installing a grout curtain to divert groundwater away from the CWR to the west/northwest. Figure 2 shows a proposed target area (red dashed line) along Section A-A′ that would cut off groundwater from infiltrating the CWR. The thin black dashed lines on either side and below the darkest green area denote the "shadow effect" that occurs below a detected seepage flow path. A good analogy for explaining the shadow effect is to think of the survey as shining a flashlight at something from above. If there is a solid object (the flow path or other conductive pathway) the top will be illuminated but a shadow will be cast below the object. Note how the green shaded area spreads out going down through the model. The darkest green area represents the area where electric current (interpreted as groundwater) is most concentrated.

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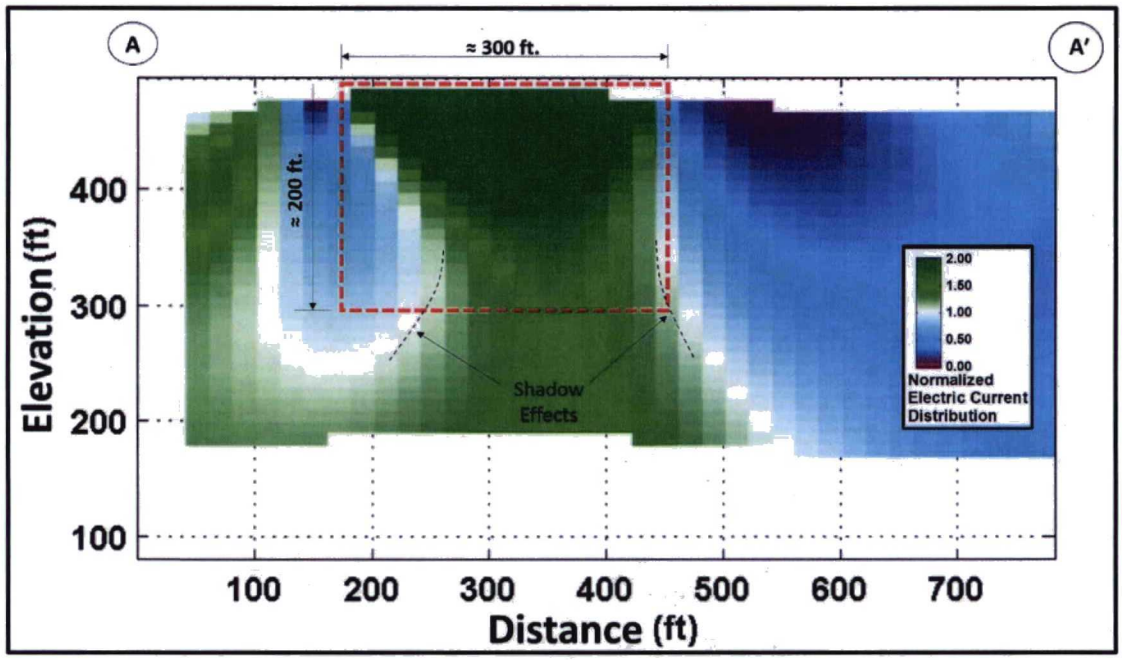

Figure 2 – Phase 1 Proposed Grout Curtain Location (Survey 1 ECD Model Section A-A′)

In the Phase I work, three different survey configurations were employed to characterize groundwater flow paths and patterns into and out from the CWR—energizing the site from three different perspectives. However, only one survey (Survey 1), targeted groundwater infiltration from the south. Because the Phase I work only identified the northernmost limits of the southwest and southeast infiltration flow paths, the Phase 1 report recommended that exploratory drilling be performed to confirm and better define the limits of these groundwater flow paths. Since then, Willowstick has been asked to perform two additional surveys to confirm and further characterize the noted infiltration flow paths from the southeast/ southwest into the CWR, which is the purpose of this Phase II investigation.

Phase II Survey Layouts

The two surveys completed for the Phase II work are herein referred to as Survey 4 and 5, numbered after the first three completed as part of the Phase I work of 2016. Survey 4 was designed to energize more in alignment with the southeast flow path (identified in 2016), and Survey 5 was designed to energize more in alignment with the southwest flow path (also identified in 2016) to further characterize and delineate their locations, depths and widths. Figures 3 and 4 present the survey layouts for Surveys 4 and 5, respectively.

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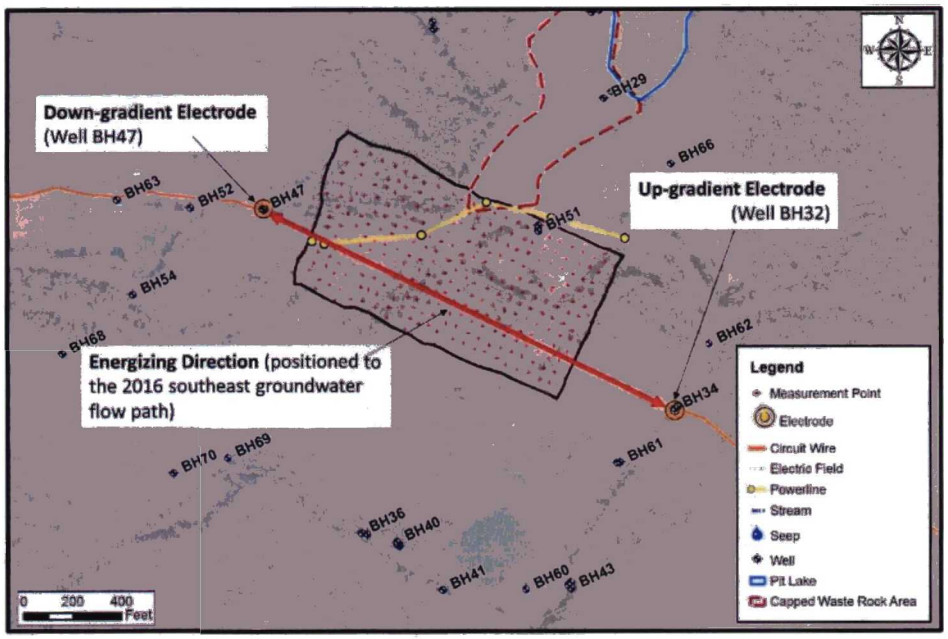

Figure 3 – Survey 4 Layout

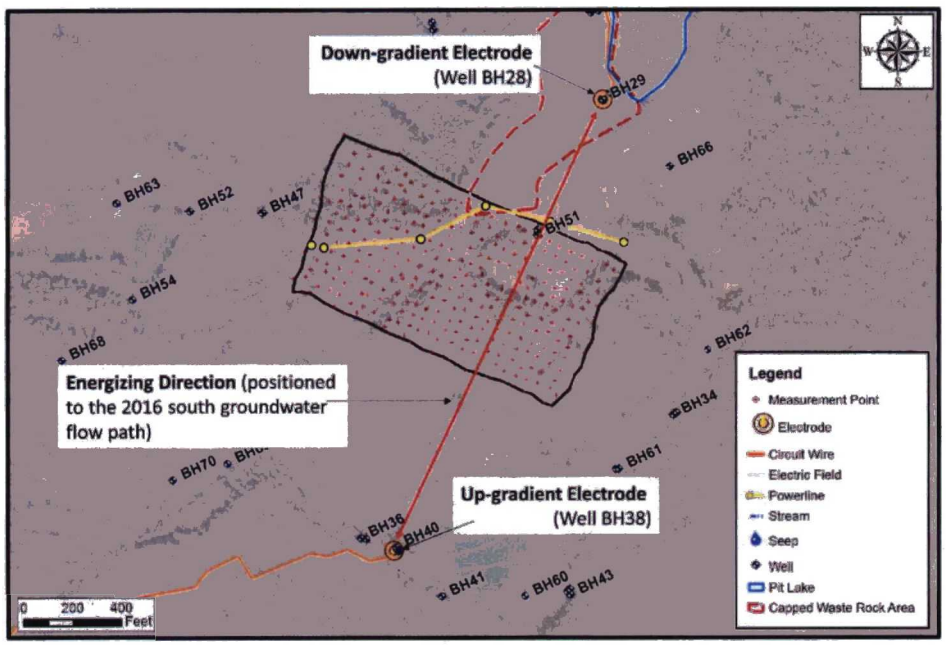

Figure 4 – Survey 5 Layout

Survey 4 Results

The purpose of Survey 4 was to further characterize the southeast flow path. Survey 4 utilized an upgradient electrode placed in monitoring well BH-32 and a downgradient electrode in monitoring well BH-47—energizing electric current to flow more favorably along the southeast flow path. Figure 5 presents the ratio response map for Survey 4 (see Appendix A for a detailed explanation of how ratio response maps are created).

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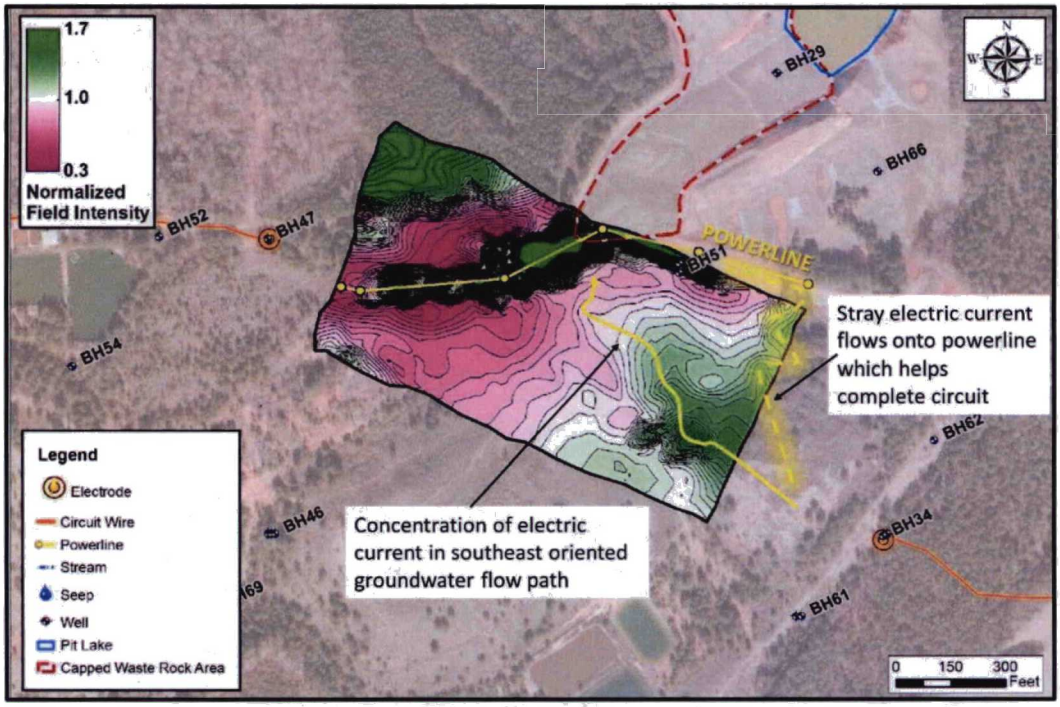

Figure 5 – Survey 4 Ratio Response Map with Interpretive Markings

The ratio response map is simply a "footprint" map showing the relative intensity of the magnetic field indicating where electric current flow is stronger (green) or weaker (purple) than predicted based on a homogeneous background model. As can be seen, electric current exhibits a strong signature along the powerline crossing over the study area. In Survey 1 (Phase I investigation), the powerline was not noted, and because the energizing direction was almost perpendicular to the powerline in that survey, the powerline did not help complete the circuit. In fact, the powerline did not appear to conduct the signature electric current in any of the Phase 1 surveys. However, in Survey 4, the powerline is oriented such that it helps complete the circuit. As a consequence, some electric current flows onto the powerline as observed in Figure 5. The powerline is grounded at each power pole allowing the signature current to access via the grounding wires. Aside from the powerline's interference, the electric current does follow and delineate well what appears to be the same "southeast" flow path of 2016. This is highlighted by a solid yellow arrow.

A strong signal also occurs in the "gully" area of the survey's northwest corner, but almost no evidence of a path that continues from the rest of the survey (above the CWR) down to that area. It appears disconnected from the flow paths identified above the CWR, and it may be a "wet" gully without anything but shallow water—unrelated to the flow paths detected above the CWR.

To better interpret the data, the ratio response data was filtered and processed by an inversion algorithm designed to predict the distribution of electric current flow in three-dimensional space within the subsurface study area. The inversion result is referred to as an Electric Current Distribution or ECD model. For a detailed explanation of how the ECD model is created, see Appendix A. Figure 6 presents a slice from the ECD Model created for Survey #4.

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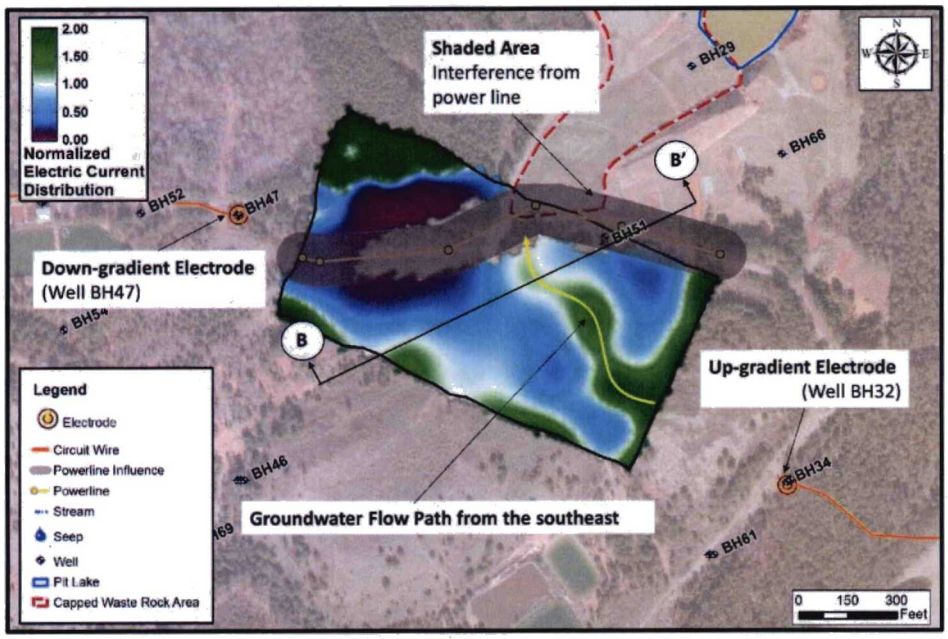

Figure 6 – Survey 4 ECD Model Slice (Elevation 395 feet)

The southeast flow path is even more apparent in the ECD model, as identified by the sinuous green-shaded zone with the yellow line. A gray "cloud" shades the area where measurements were influenced by the flow of electric current on the powerline. There are no other anomalous areas except for a hint of the southwest flow path, which will be shown in detail by Survey 5. Please know that electric current is biased to flow perpendicular to the southwest flow path, therefore we should not expect to see it manifest strongly in this survey. Figure 7 presents a cross-sectional view of the southeast flow path at B-B′, taken upgradient of the CWR and outside the influence of the powerline.

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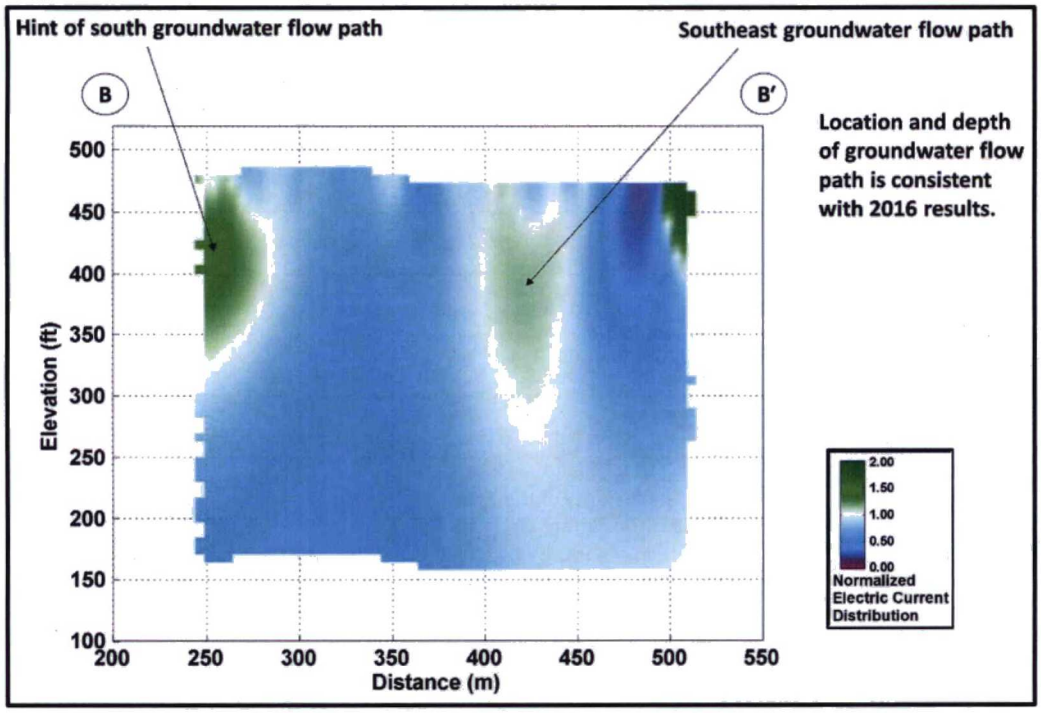

Figure 7 – Survey 4 ECD Model Section B-B′

Survey 4's ECD model shows the flow path to be in the same location and at the same depth as that identified for Survey 1. However, as will be shown when comparing Survey 4 with Surveys 1 and 5, the southeast flow path is much smaller than the southwest flow path—it has a similar depth but is much smaller in width and in electric current intensity.

Survey 5 Results

The purpose of Survey 5 was to further characterize the southwest flow path. Survey 5 utilized an upgradient electrode in monitoring well BH-38 coupled with a downgradient electrode in monitoring well BH-29, designed to energize in close alignment with the southwest flow path. Figure 8 presents the ratio response map for Survey 5.

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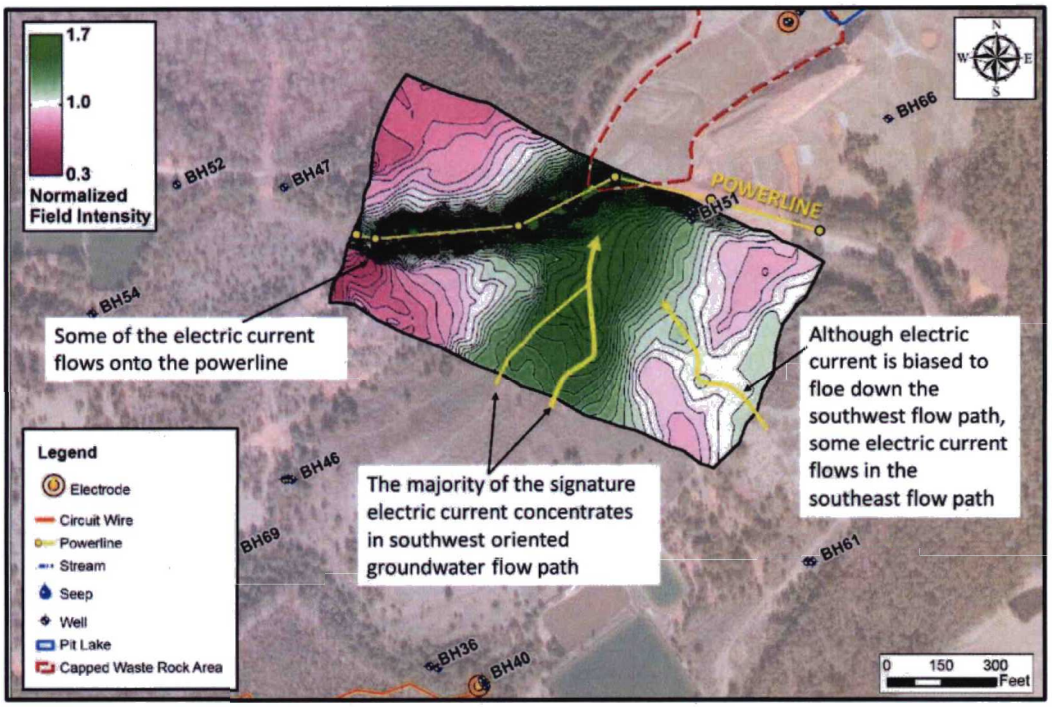

Figure 8 – Survey 5 Ratio Response Map with Interpretive Markings

The most important observation is that electric current concentrates very strongly along the southwest flow path, and some hint of the southeast flow path is also noted. As with Survey 4, electric current is influenced by the powerline crossing over the study area, more so than was expected in this survey since the energizing direction is more perpendicular to the powerline. There is little to no evidence of any flow to the northwest. To better interpret the data, the ratio response data was processed by an inversion algorithm designed to predict the distribution of electric current flow in three-dimensional space within the subsurface study area. Figure 9 presents a view of the ECD Model created for Survey 5 while Figure 10 shows a cross-sectional view of the southwest groundwater flow path taken from the ECD model along section C-C′.

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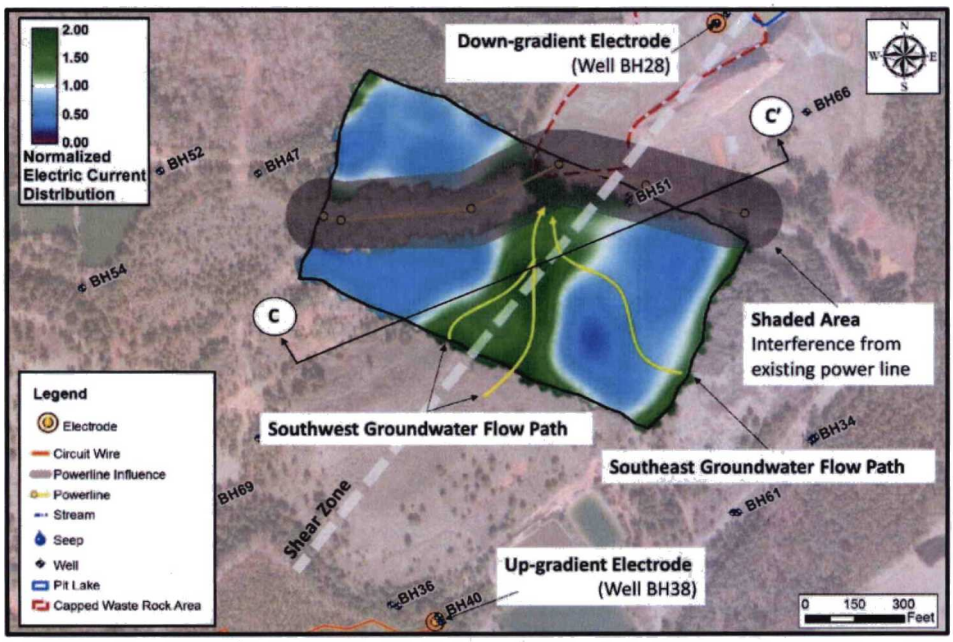

Figure 9 – Survey 5 ECD Model Slice (Elevation 395 feet)

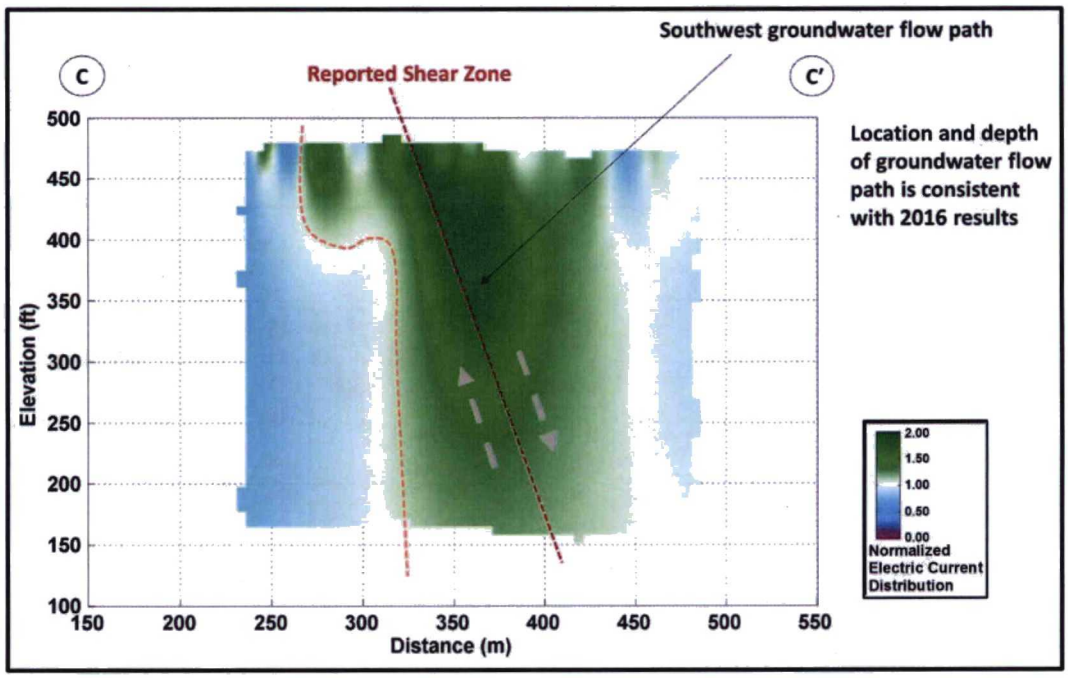

Figure 10 – Survey 5 ECD Model Section C-C′

Survey 5's ECD model best identifies the southwest flow path. A hint of the southeast flow path is also visible in Figure 9. Of significant importance is the orientation of the southwest flow path: it appears to align with a reported shear zone. If the southwest flow path follows a shear zone into and beneath the CWR, it is much more likely that the southeast flow path terminates when it intersects the shear zone. It is not likely that once the flow paths merge that they bifurcate, part

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becoming the primary flow path beneath the CWR and part becoming a west/northwest flow path, as implied in the Phase I report.

Regarding the west/northwest flow path, we were unaware of the powerline crossing the area when we interpreted the Phase I data. Therefore, it is possible that this "flow path", noted in the Phase 1 report, is actually from electric current flowing onto the powerline from the west; in both the Survey 4 and 5 ECD models, there is little evidence of a west/northwest flow path.

Survey 5's ECD model shows the southwest flow path to be in the same location and at the same depth as that identified in Survey 1. When comparing survey results (Surveys 1, 4 and 5), the southwest flow path is much larger than the southeast flow path—having a similar depth but with more electric current intensity and a much larger width—suggesting the presence of a major geologic feature such as the reported shear zone.

Survey Comparisons

Here we present side-by-side comparisons of Surveys 1, 2 and 3 ECD models in both plan and cross-sectional views (see Figures 12 and 13). Because of interference from the powerline, which differed slightly with each individual survey, it was not possible to take cross-sectional slices in the same locations. Nevertheless, the comparisons show the surveys corroborate each other rather well; all three surveys indicate the presence of preferential groundwater flow close to 300 ft elevation msl. Further, both Surveys 1 and 5 suggest the southwest flow path follows a slanted plane, most likely the reported shear zone.

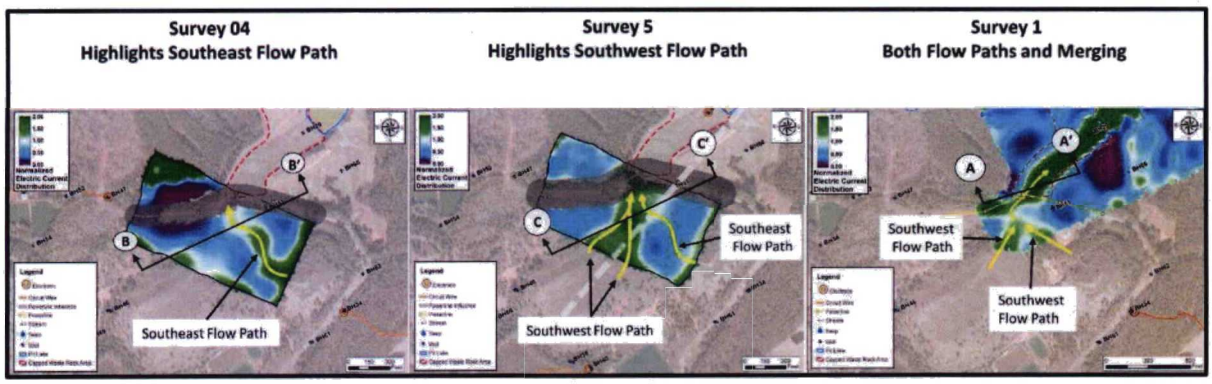

Figure 12 – Survey Plan View Comparisons

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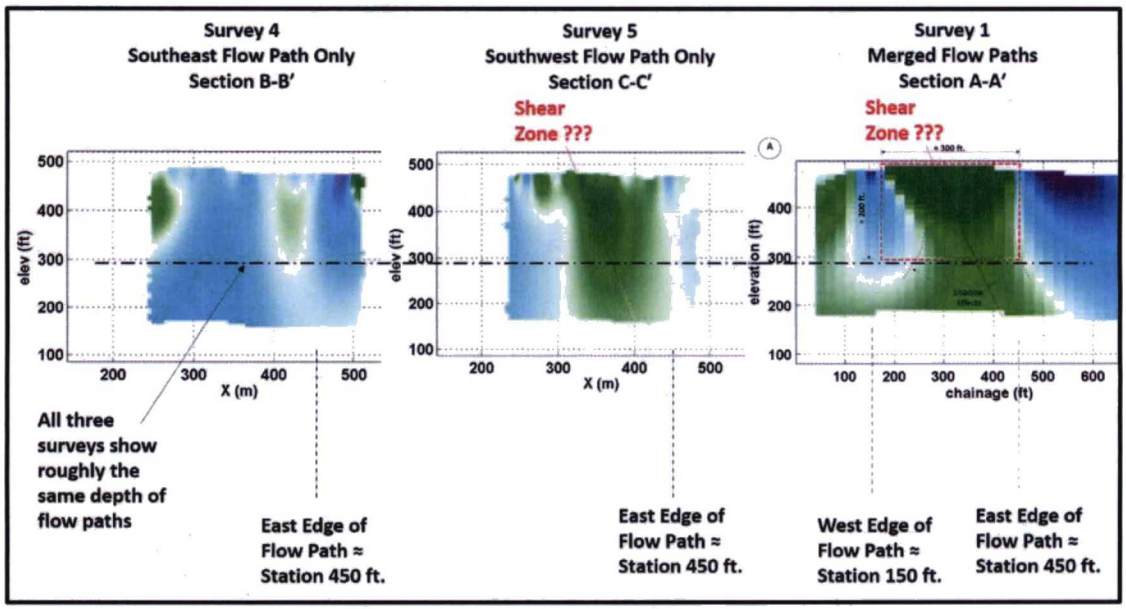

Figure 13 – Survey Cross-Section Comparisons

Conclusions

Based on the results from Survey 1 (in 2016) and Surveys 4 and 5 (in 2017), we conclude the following:

1. Two groundwater flow paths exist south of the CWR—referred to as southwest and southeast flow paths.
2. The southwest flow path appears to follow the alignment of a shear zone known to exist beneath the site.
3. The southwest flow path is the dominant flow path south of the CWR—which suggests a strong geologic feature such as the shear zone.
4. The two flow paths merge just upgradient of the CWR and appear to infiltrate the CWR.
5. The depth of flow paths is estimated to be roughly 200 feet below ground surface.

The target area (red dashed rectangle given in the Phase 1 report) appears to be valid. We found nothing that would change this target location. However, it is unknown if the target area were grouted off that it would re-direct groundwater to flow westward and northward away from the CWR as inferred in the Phase I report. We do not believe a west/northwest flow path exists that would help re-direct the groundwater away from the CWR. Regardless, we still recommend that exploratory drilling be performed to confirm and define the limits of the observed groundwater flow paths. The recommended drill targets (locations and depths) are provided in the Phase I report (see Appendix A).

The 2017 Willowstick Phase II investigation has confirmed and also further characterizes groundwater flow paths near the southwest corner of the CWR. The additional surveys and comparison of all surveys performed has proven helpful in interpreting the data as well as given greater confidence in the results. This information is meant to serve as a guide for further exploration and remedial work. Willowstick will keep all data, maps and models on file for future

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analysis and reference. Willowstick is committed in assisting Black & Veatch with whatever effort is required to fully understand the information presented herein.

If you have any questions please feel free to contact me at your convenience.

Best regards,

Val Kofoed, P.E.
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